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Practitioner's Docket No. 939_014 *PATENT*

NEW APPLICATION TRANSMITTAL

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Elizabeth A. VanAntwerp

Box Patent Application
Assistant Commissioner for Patents
Washington D.C. 20231

Transmitted herewith for filing is the patent application of:

Inventor 1: Yukihisa TAKEUCHI
Address: c/o NGK Insulators, Ltd.
2-56, Suda-Cho, Mizuho-Ku
Nagoya-City, Aichi-Prefecture 467-8530
Japan

Inventor 2: Iwao OHWADA
Address: c/o NGK Insulators, Ltd.
2-56, Suda-Cho, Mizuho-Ku
Nagoya-City, Aichi-Prefecture 467-8530
Japan

Title: ABSOLUTE VALUE CALCULATING ELEMENT

1. Papers enclosed

A. Required for filing date under 37 CFR 1.53(b) (Regular) are:

8 Page(s) of Specification
2 Page(s) of Claims
1 Page(s) of Abstract
2 Sheets of Formal Drawings (Figs. 1-4)

B. Other Papers Enclosed

[x] A Patent Application Bibliographic Data Sheet
[ ] A Preliminary Amendment
[x] A combined Declaration and Power of Attorney
[ ] An Information Disclosure Statement
[ ] PTO Form-1449
[x] An Assignment Transmittal and Assignment of the invention to NGK Insulators, Ltd.

2. Additional Papers to Follow Under Separate Cover

[x] A Claim for Priority and a certified copy of 11-323,206 filed November 12, 1999 in Japan

3. Small Entity Status

[ ] A statement that this filing is by a small entity is attached.
[ ] A separate refund request accompanies this paper.
[ ] was filed on _____ (original).

4. The filing fee has been calculated as shown below:

A.	Filing Fee	
	[x] Original Patent Application (37 C F R 1 16(a) --$710.00, Small Entity--$355 00)	$ 710.00
B.	Fees for Claims (**5** Claims; **1** Indep.)	
	[ ] each independent claim in excess of 3 (37 C F R 1 16(b)--$80 00, small entity--$40 00)	$ .00
	[ ] each claim in excess of 20 (37 C F R. 1 16(c)--$18.00, small entity--$9.00)	$ .00
	[ ] multiple dependent claim(s) (37 C F R 1 16(d)--$270 00· small entity--$135 00)	$ .00
C.	[x] Assignment Fee	$ 40.00
	Total Fees Due	**$ 750.00**

5. Payment of Fees and Authorization to Charge Additional Fees or Credit Overpayment

[x] A check in the amount of $750.00 is enclosed.
[x] The Commissioner is hereby authorized to charge payment of the following fees associated with this communication or credit any overpayment to Deposit Account No. 50-1446. A duplicate copy of this sheet is enclosed.
[x] Any additional filing fees required under 37 CFR 1.16.
[x] Any patent application processing fees under 37 CFR 1.17.

Respectfully submitted,

October 11, 2000
Date

Stephen P. Burr
Reg. No. 32,970

SPB/eav

BURR & BROWN
P.O. Box 7068
Syracuse, NY 13261-7068

Customer No.: 025191
Telephone:(315) 233-8300
Facsimile:(315) 233-8320

INVENTOR INFORMATION

Inventor One Given Name:: Yukihisa
Family Name:: TAKEUCHI
Postal Address Line One:: c/o NGK Insulators, Ltd.
Postal Address Line Two:: 2-56, Suda-Cho, Mizuho-Ku
City:: Nagoya-City
Country:: Japan
Postal or Zip Code:: 467-8530
City of Residence:: Nishikamo-Gun
Country of Residence:: Japan
Citizenship Country:: Japan
Inventor Two Given Name:: Iwao
Family Name:: OHWADA
Postal Address Line One:: c/o NGK Insulators, Ltd.
Postal Address Line Two:: 2-56, Suda-Cho, Mizuho-Ku
City:: Nagoya-City
Country:: Japan
Postal or Zip Code:: 467-8530
City of Residence:: Nagoya-City
Country of Residence:: Japan
Citizenship Country:: Japan

CORRESPONDENCE INFORMATION

Name Line One:: Stephen P. Burr
Name Line Two:: Burr & Brown
Address Line One:: P.O. Box 7068
City:: Syracuse
State or Province:: New York
Country:: US
Postal or Zip Code:: 13261-7068
Telephone One:: (315) 233-8300
Fax One:: (315) 233-8320
Electronic Mail One:: vananl@macklaw.com

APPLICATION INFORMATION

Title Line One:: ABSOLUTE VALUE CALCULATING ELEMENT
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Application Type:: Utility
Docket Number:: 939_014
Secrecy Order in Parent Appl.?:: No

REPRESENTATIVE INFORMATION

Registration Number One:: 32970
Registration Number Two:: 32402

Registration Number Three:: 44963

PRIOR FOREIGN APPLICATIONS

Foreign Application One:: 11-323,206
Filing Date:: 11-12-1999
Country:: Japan
Priority Claimed:: Yes

Source:: PrintEFS Version 1.0.1

Specification

Absolute Value Calculating Element

Field of the Invention

The present invention relates to an absolute value calculating element for converting alternating-current signals into direct-current signals.

Description of the Prior Art

Conventionally known absolute value calculating means for performing absolute value calculation of alternating voltage signals and converting the same into direct-current voltage signals are full-wave rectification circuits arranged by assembling diodes or circuits in which such circuits are combined with transformers.

However, it will be suffice to provide a single diode in case of performing half-wave rectification in such a circuit employing diodes while remaining half-waves will not be output but ignored. On the other hand, a plurality of elements to be imposed will be required in case of forming a circuit in which full-wave rectification is performed so that forming the circuit will be troublesome. Moreover, while both of these circuits enable conversion in an effective manner since electric signals are directly converted into electric signals, forward voltage drop owing to diodes will not be zero so that it may cause errors in

case of performing absolute value calculation of minute signals by using diodes.

The present invention has thus been made in view of these problems, and it is a subject thereof to provide an absolute value calculating element for converting alternating-current signals into direct-current signals with a small amount of imposed elements and without causing specific voltage drop.

Summary of the Invention

For solving the above subject, the invention of Claim 1 is provided with electrostrictive elements and a detecting means for detecting an amount of deformation thereof, wherein an alternating-current signal is calculated into an absolute value and output by impressing the alternating-current signal to the electrostrictive elements for deforming the same and by converting a distortion of the electrostrictive elements into an electric signal by using the detecting means.

In the invention of Claim 2, a piezoelectric/electrostrictive element is provided that is deformed in proportion to the amount of deformation of the electrostrictive elements in the invention of Claim 1, wherein an alternating-current signal is calculated into an absolute value and output by impressing the

alternating-current signal to the electrostrictive element for deforming the same and by outputting electromotive force generated by the deformation of the piezoelectric/electrostrictive element.

In the invention of Claim 3, the electrostrictive elements and the piezoelectric/electrostrictive element are overlapped and pinched between a rigid body that is not deformed in the invention of Claim 2.

In the invention of Claim 4, one end of the electrostrictive elements in a deforming direction thereof is fixed while the other end of the electrostrictive element is fixedly attached to one surface of an elastic plate body, which one end is fixed and its other end is formed as a free end, and a plate-like piezoelectric/electrostrictive element is fixedly attached to the other surface of the elastic plate body in the invention of Claim 2.

In the invention of Claim 5, the electrostrictive elements and the piezoelectric/electrostrictive element are formed to assume a plate-like shape in the invention of Claim 2, wherein the electrostrictive elements are fixedly attached to one surface of the plate-like elastic plate body while the piezoelectric/electrostrictive element is fixedly attached to the an opposing surface of the plate-like elastic body.

Brief Explanation of the Drawings

Fig. 1 is an explanatory view showing one example of an absolute value calculating element of an embodiment of the present invention.

Fig. 2 is a view showing characteristics of impressed voltage-deformation of electrostrictive elements.

Fig. 3 is an explanatory view showing another embodiment of the present invention.

Fig. 4 is an explanatory view showing still another embodiment of the present invention.

Description of the Preferred Embodiments

Embodiments for materializing the present invention will now be explained with reference to the drawings. Fig. 1 is a schematic view showing one example of an absolute value calculating element according to the present invention, wherein an actuator 2 of substantially columnar shape is formed by overlapping a plurality of disk-like shaped electrostrictive elements 1, and a sensor element 3 of substantially identical shape is provided in an overlapping manner to be succeeding to the actuator 2. Both of the actuator 2 and the sensor element 3 are pinched between a rugged rigid body 4 that will not be deformed, and the sensor element 3 is provided to be deformable in accordance with deformations in the actuator 2 such that

a dimension $\underline{t}$ in an entire height direction as illustrated in Fig. 1 becomes constant. An alternating signal source 5 is connected to each of the electrostrictive elements 1 of the actuator 2 so that electromotive force of the sensor element 3 will be extracted.

It should be noted that the sensor element 3 be preferably a piezoelectric element, e.g. of PZT, it is alternatively possible to employ, instead of such an element utilizing piezoelectric effects, elements exhibiting piezoresistant effects such as a semiconductor gauge, an element utilizing magnetoresistant effects, a differential transformer, an eddy-current sensor, an element for detecting variations in capacities, or an electrostrictive element. Moreover, the actuator 2 may be a conventionally known MLP in which a plurality of electrostrictive elements is formed to assume a laminated structure. However, in case a piezoelectric element is formed of ceramics such as PZT to be used as the sensor element, the actuator may be similarly formed of ceramics such that both members may be integrally formed in a simple and effective manner.

Since the electrostrictive elements 1 are deformed in an identical direction upon receipt of positive/negative voltage signals as illustrated in the characteristics of impressed voltage-deformation of Fig. 2, the actuator 2

will be accordingly deformed in an identical direction upon impressing positive/negative voltage signals for performing absolute value calculating actions. Thus, an electric signal such as electromotive force that is expressed as an absolute value will be generated from the sensor element that is deformed in accordance with the actuator 2.

Since absolute value calculation of alternating-current signals may be performed by an integrally formed element, high-integration is enabled without the necessity of arranging a different circuit, and output of absolute values of favorable characteristics may be obtained with small input signals since electrostrictive elements do not exhibit threshold characteristics such as forward voltage drop as it is the case with diodes.

Since the arrangement does not perform direct conversion of electric signals to electric signals, inputs and outputs may be electrically isolated from each other so that no conducting condition will be generated between inputs and outputs even in case of degradations or damages of elements. It is further possible to provide a mechanism that does not respond to high frequencies since mechanical displacements are interposed, and it is accordingly possible to incorporate functions of a low pass filter.

Fig. 3 illustrates another embodiment in which a fixed

bottom surface 7a and a wall surface 7b are provided onto which bottom surface the actuator 2 is fixed. Its upper surface 2a is fixedly attached to a rear surface of an elastic plate-like body 8 with one end thereof being fixed to the wall surface, and a plate-like sensor element 9 is fixedly attached to an upper surface of the plate-like body 8. The sensor element 9 may be preferably comprised of a piezoelectric unimorph.

Also with this arrangement, deformation of the actuator 2 causes deflection of the plate-like body 8 so that the sensor element 9 is accordingly deformed or distorted through the deflection to thus generate electromotive force. It is thus possible to perform absolute value calculation of the alternating voltage signals and to output the absolute value signals. It should be noted that the plate-like body 8 may be a metallic plate or formed of resin or ceramics.

In case the elastic plate-like body is interposed, an actuator 10 may be similarly formed to assume a plate-like shape in addition to the sensor element 9 as illustrated in Fig. 4. In this manner, the entire absolute value calculating element may be manufactured in a simpler manner.

For obtaining a sufficient amount of deformation of the actuator 2, alternating-current signals to be input

shall be amplified by using an operational amplifier or the like such that output signals expressed as absolute values and having high S/N ratios may be obtained.

As explained so far in details, the present invention enables it to perform absolute value calculation of alternating-current signals by using an integrally formed element and to perform high-integration without the necessity of providing a peripheral circuit. Though diodes would cause voltage drop though it may be a forward one, a piezoelectric/electrostrictive element will not exhibit such threshold-like characteristics so that it is possible to perform absolute value calculation in a favorable manner also with small signals. Since no direction conversion of electric signals into electric signals is performed, the input and output may be electrically isolated.

What is claimed is:

1. An absolute value calculating element comprising electrostrictive elements and a detecting means for detecting an amount of deformation thereof, wherein an alternating-current signal is calculated into an absolute value and output by impressing the alternating signal to the electrostrictive elements for deforming the same and by converting a distortion of the electrostrictive elements into an electric signal by using the detecting means.

2. An absolute value calculating element in which a piezoelectric/electrostrictive element is provided in the absolute value calculating element as recited in Claim 1 that is deformed in proportion to the amount of deformation of the electrostrictive elements, wherein an alternating-current signal is calculated into an absolute value and output by impressing the alternating signal to the electrostrictive element for deforming the same and by outputting electromotive force generated by the deformation of the piezoelectric/electrostrictive element.

3. The absolute value calculating element as recited in Claim 2, wherein the electrostrictive elements and the piezoelectric/electrostrictive element are overlapped and pinched between a rigid body that is not deformed.

4. The absolute value calculating element as recited

in Claim 2, wherein one end of the electrostrictive elements in a deforming direction thereof is fixed while the other end of the electrostrictive element is fixedly attached to one surface of an elastic plate body, which one end is fixed and its other end is formed as a free end, and a plate-like piezoelectric/electrostrictive element is fixedly attached to the other surface of the elastic plate body.

5. The absolute value calculating element as recited in Claim 2, wherein the electrostrictive elements and the piezoelectric/electrostrictive element are formed to assume a plate-like shape, wherein the electrostrictive elements are fixedly attached to one surface of the plate-like elastic plate body while the piezoelectric/electrostrictive element is fixedly attached to the an opposing surface of the plate-like elastic body.

Abstract

A sensor element formed of PZT is overlapped onto an actuator formed of electrostrictive elements, and both members are pinched between a rigid body that is not deformed; by impressing an alternating-current signal to the actuator, the sensor element is deformed in accordance with an amount of deformation thereof for utilizing the thus generated electromotive force of the sensor element as a signal for absolute value calculation.

FIG. 1

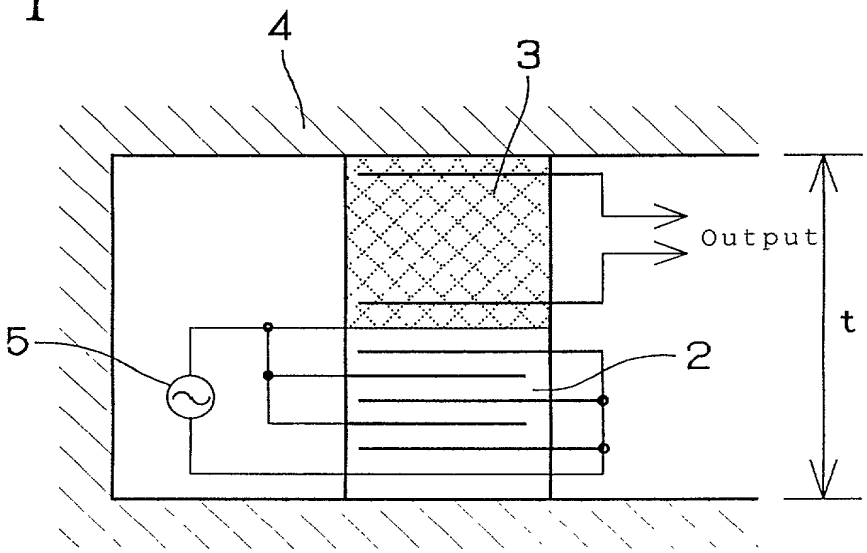


FIG. 2

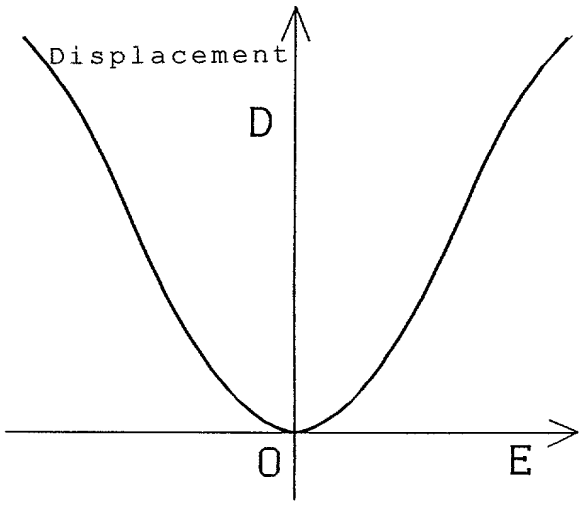


FIG. 3

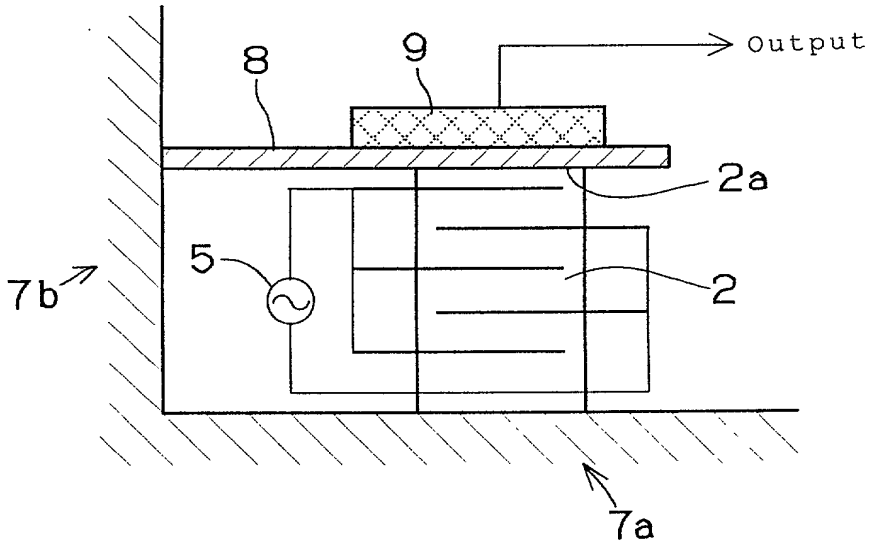
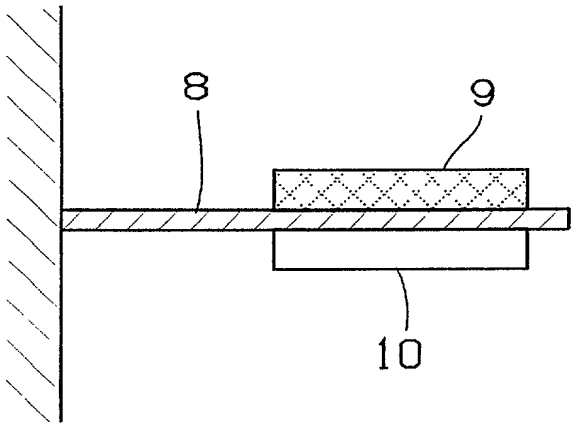


FIG. 4



Declaration and Power of Attorney for Patent Application English Language Declaration		
☒ Declaration Submitted with Initial Filing ☐ Declaration Submitted After Initial Filing (surcharge (37 CFR 1.16(e) required)	**Attorney Docket No.**	939 014
	First Named Inventor	Yukihisa TAKEUCHI
	COMPLETE IF KNOWN	
	Application Number	
	Filing Date	
	Group Art Unit	

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

ABSOLUTE VALUE CALCULATING ELEMENT

the specification of which (check one)

☒ is attached hereto.

☐ was filed on _____ as United States Application No. _____.

☐ was described and claimed in PCT International Application Number _____ filed on _____ and as amended under PCT Article 19 on _____ (*if any*).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119(a)-(d) or Section 365(b) of any foreign application(s) for patent or inventor's certificate, or Section 365(a) of any PCT International Application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate or PCT International Application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application(s)			Priority Not Claimed
11-323206	Japan	12 Novemver 1999	
(Number)	(Country)	(Day/Month/Year Filed)	☐
(Number)	(Country)	(Day/Month/Year Filed)	☐
(Number)	(Country)	(Day/Month/Year Filed)	☐
(Number)	(Country)	(Day/Month/Year Filed)	☐

I hereby claim the benefit under 35 U.S.C. Section 119(e) of any United States Provisional Application(s) listed below:

(Application Serial No.)	(Filing Date)
(Application Serial No.)	(Filing Date)
(Application Serial No.)	(Filing Date)

I hereby claim the benefit under 35 U.S.C. Section 120 of any United States Application(s), or Section 365(c) of any PCT International Application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International Application in the manner provided by the first paragraph of 35 U.S.C. Section 112, I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, C.F.R. Section 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application:

(Application Serial No.)	(Filing Date)	(Status) (patented, pending, abandoned)
(Application Serial No.)	(Filing Date)	(Status) (patented, pending, abandoned)
(Application Serial No.)	(Filing Date)	(Status) (patented, pending, abandoned)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. (*List names and Registration Number*)

Stephen P. Burr, Reg. No. 32,970
Kevin C. Brown, Reg. No. 32,402
Charu Narang Moody, Reg. No. 44,963

Send Correspondence to:

Stephen P. Burr
Burr & Brown
P.O. Box 7068
Syracuse, NY 13261-7068

Customer No.: 25191

Direct Telephone Calls to: (*name and telephone number*)

Stephen P. Burr, (315) 233-8300

Full name of sole or first inventor
Yukihisa TAKEUCHI
Sole or first inventor's signature — Date
Yukihisa Takeuchi — 03/10/00
Residence
Nishikamo-gun, Aichi-ken 470-0204 JAPAN
Citizenship
Japanese
Post Office Address
2-56, Suda-cho, Mizuho-ku, Nagoya-shi, Aichi-ken 467-8530 JAPAN

Full name of second inventor, if any
Iwao OHWADA
Second inventor's signature — Date
Iwao Ohwada — 03/10/00
Residence
Nagoya-shi, Aichi-ken 467-0873 JAPAN
Citizenship
Japanese
Post Office Address
2-56, Suda-cho, Mizuho-ku, Nagoya-shi, Aichi-ken 467-8530 JAPAN